REMARKS

Withdrawal of the Previously Proposed Claim Amendments

In the December 9, 2005 Response to Final Office Action, Applicants proposed certain claim amendments in order to expedite the current proceeding and to place the present application in condition for allowance. However, the Examiner refused to enter such claim amendments as proposed in the December 9, 2005 Response (see the December 21, 2005 Advisory Action).

In light of the foregoing, Applicants hereby expressly withdraw the previously proposed claim amendments in the December 9, 2005 Response, and request the Examiner to enter the claim amendments proposed herein instead.

Status of Claims

Applicants have hereby cancelled claims 30-31 and amended claims 29, 32-34, and 60. Consequently, claims 29, 32-41, and 60, as amended, are pending for examination, while claims 42-59 are withdrawn from consideration.

Response to the Objection to Drawings

In the October 3, 2005 Final Office Action, the Examiner objected to the drawings of the present application under 37 C.F.R. §1.83(a), for failure to show every feature of the invention specified in the claims. Specifically, the Examiner asserted that the limitation of "an interface having an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å" as recited in the claims must be shown in the drawings or be canceled from the claims.

In response, Applicants hereby submit a replacement drawing sheet for Figure 2. On the replacement drawing sheet, the interface layers between the carbon-containing layers 24', 28', and 32' and the adjacent silicon germanium layers 26', 30', and 34' have been specifically identified by reference numerals 325, 327, 329, 331, and 333. An annotated drawing sheet showing changes made to Figure 2 is also enclosed for the Examiner's reference. The instant specification has been correspondingly amended on pages 14 and 15 to identify such interface layers 325, 327, 329, 331, and 333.

Applicants hereby further submit a Declaration signed by one of the inventors of the present application, Dr. Jack O. Chu, attesting to the fact that the layered structure shown in Figure 2, including the SiC/SiGe interface layers, was fabricated using an UHV-CVD process that was conducted at a growth temperature of about 500°C to deposit about one (1) monolayer to about ten (10) monolayers of SiC or SiGe per minute (see the Chu Declaration, page 2, paragraphs 3-5). Because each monolayer of SiC or SiGe is about 6Å in thickness, and because the carbon concentration changes in the deposited layers were immediately effectuated upon change of the carbon precursor flow rate, it can be readily inferred that the interface layers shown in the transmission electron microscopy (TEM) photograph of Figure 2 represent abrupt carbon concentration changes that occurred within 1-10 monolayers of SiC or SiGe, which corresponds to a layer thickness in the range from about 6Å to about 60Å (see the Chu Declaration, page 3, paragraph 6).

Unfortunately, the secondary ion mass spectrometry (SIMS) results as shown in Figure 1 of the present application had very limited depth resolution, i.e., about 125 Å/decade at the time of its analysis. Therefore, the SIMS results as shown in Figure 1 can only illustrate the amount of overall carbon concentration changes occurred between the SiC and SiGe layers, but they cannot show the abruptness of such changes at the SiC/SiGe interfaces, due to the limited depth resolution of the SIMS results (see the Chu Declaration, page 3, paragraph 7).

Even the TEM photograph of Figure 2, which was taken at a magnification scale of about 40,000X, cannot show the abruptness of such changes at the SiC/SiGe interfaces, but it can only

indicate the approximate positions of the interfaces in relation to the SiC and SiGe layers (see the Chu Declaration, page 2, paragraph 5).

Therefore, although due to the instrument limitations, the exact thicknesses of the interface layers 325, 327, 329, 331, and 333 as shown in Figure 2 (over which the abrupt carbon concentration changes have occurred) cannot be graphically shown, such layer thicknesses can be readily inferred from the deposition rate achieved by the UHV-CVD process.

It is therefore clear that the amended Figure 2 in the replacement drawing sheet shows interfaces (i.e., interface layers 325, 327, 329, 331, and 333) that each has an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å, in compliance with the requirements of 37 C.F.R. §1.83(a).

Based on the foregoing, Applicants respectfully request the Examiner to reconsider, and upon reconsideration to withdraw, the drawing objections.

Response to §103(a) Rejections of Claims 29-32 and 60

In the October 3, 2005 Office Action, the Examiner rejected claims 29-32 and 60 under 35 USC §103(a) for alleged obviousness over Swanson et al. U.S. Patent No. 6,552,375 (hereinafter "Swanson") in view of Shindo et al. U.S. Patent No. 6,137,120 (hereinafter "Shindo"), Tay et al. U.S. Patent No. 5,296,258 (hereinafter "Tay"), or Fang et al. U.S. Patent No. 6,114,745 (hereinafter "Fang").

In response, Applicants have cancelled claims 30-31 and amended claim 29, from which claim 32 depend, to positively recite: "a layer of single crystalline SiC over said upper surface, said single crystalline SiC layer and said upper surface of single crystalline Si define an interface having an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å." Further, Applicants have amended claim

60 to recited "one or more layers of single crystalline materials... [comprising] at least one layer of single crystalline SiC or single crystalline SiGeC, said one or more single crystalline material layers and said upper surface of single crystalline Si define one or more interfaces having an abrupt change in C concentration of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å."

Support for such an amendment can be found throughout the instant specification. See, for example, the sentence between pages 6 and 7, which states that the present invention provides very thin epitaxial layers of silicon carbon or silicon germanium carbon having abrupt transitions of several atomic widths in carbon concentration between *adjacent single crystal layers*; see also the first paragraph on page 13, which states that the present invention provides for epitaxial deposition of *single crystal silicon carbon and silicon germanium carbon layers* of desired thickness and high crystallographic perfection suitable for device applications.

As mentioned in the instant specification, abrupt carbon concentration changes between adjacent single crystal layers could not be achieved prior to the present invention (see the sentence between pages 6 and 7 of the instant specification), because abrupt carbon concentration changes tend to disrupt the crystal lattice during epitaxial growth of single crystal layers. When the carbon concentration exceeds a critical value (i.e., the equilibrium solid solubility) in single crystal silicon, silicon carbide (beta-SiC) tends to precipitate out of the crystal lattice to form polycrystalline, instead of single crystalline, structures (see instant specification, page 5, lines 9-14).

Therefore, claims 29, 32, and 60 of the present invention, by reciting **an interface (or interfaces) that is defined by adjacent single crystal layers** and characterized by an **abrupt change in C concentration** of more than 1 x 10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å, delineate an important technical advancement over the prior art.

The Swanson reference only discloses an interface defined by SiC layer 218 and Si layer 216 (see Figure 2 of Swanson).

However, nothing in Swanson discloses, or even contemplates, a single crystal SiC layer 218. On the contrary, Swanson discloses that the SiC layer 21 8 is a part of the polysilicon emitter 226 (see Swanson, column 6, lines 66-67, and column 7, lines 1-4), which implies that the SiC layer 218 disclosed by Swanson is polycrystalline, instead of single crystalline.

Therefore, Swanson is deficient in teaching or suggesting an interface that is defined by adjacent single crystal layers with abrupt carbon concentration change, as positively recited by claims 29, 32, and 60 of the present application.

In the November 3, 2005 Office Action, the Examiner cited Shindo et al. U.S. Patent No. 6,137,120 (hereinafter "Shindo"), which discloses a single crystalline emitter, in attempt to remedy the above-described deficiency of Swanson (see Office Action, page 5, paragraph 4).

However, it has been well established that the Examiner cannot "pick and choose isolated elements from various prior art references and combine them so as to yield the invention in question when such combining would not have been an obvious thing to do at the time in question." See Panduit Corp. v. Dennison Manufacturing Co., 227 U.S.P.Q. 337 (CAFC 1985). Further, in order to establish obviousness, there **must be a reasonable expectation of success** in combining the prior art references to yield applicant's claimed invention, and that such a reasonable expectation of success must be found in the prior art, not in applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Even assuming *arguendo* that it was desirable to use the single crystalline emitter disclosed by Shindo in the layered structure disclosed by Swanson (despite the fact that nothing in the Swanson or the Shindo reference provides motivation or suggestion for such a combination), there **lacks reasonable expectation of success** that a single crystal SiC emitter could actually be formed over the Si buffer layer 216 disclosed by Swanson using the techniques disclosed by Swanson, while still preserving an abrupt change in C concentration of more than 1×10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å.

It is observed that when the carbon concentration exceeds a critical value (i.e., the equilibrium solid solubility) in single crystal silicon, silicon carbide (beta-SiC) tends to precipitate out of the crystal lattice to form polycrystalline, instead of single crystalline, structures.

Therefore, it is improper for the Examiner to pick and choose isolated elements from various prior art references, i.e., the single crystal emitter from Shindo and the Si buffer layer 216 from Swanson, and combine them to yield Applicants' claimed invention, in light of the lack of reasonable expectation of success in such combination.

The applied disclosures by Tay and Fang references do not teach or suggest any single crystal SiC layers and therefore cannot remedy the above-described deficiency of Swanson.

Therefore, claims 29, 32, and 60 of the present application patentably distinguish over the cited references, and Applicant respectfully request the Examiner to reconsider, and upon reconsideration to withdraw, the rejections of claims 29, 32, and 60.

Allowable Claims 33-41

In the October 3, 2005 Office Action, the Examiner stated that claims 33-41 would be allowable if rewritten in independent form and removing the reasons for the objection to the drawings.

Applicants have hereby rewritten the allowable claims 33 and 34, from which claims 35-41 depend, in independent form.

Further, Applicants have hereby amended Figure 2 of the present invention to show interface layers having abrupt changes in C concentration of more than 1×10^{18} atoms/cc over a layer thickness in the range from about 6 Å to about 60 Å, as attested to by the Chu Declaration. Therefore, the drawing objections as raised by the Examiner in the October 3, 2005 Office Action have been overcome.

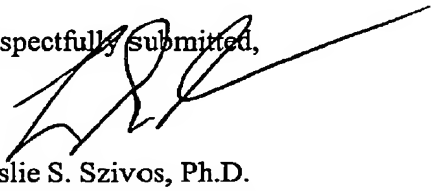
Consequently, claims 33-41 as amended herein are in condition for allowance.

CONCLUSION

Based on the foregoing, claims 1-29 and 32-60, as amended/added herein and now pending in the application, are in form and condition for allowance. Issue of a Notice of Allowance for the application is therefore requested.

If any issues remain outstanding, incident to the formal allowance of the application, the Examiner is requested to contact the undersigned attorney at (516) 742-4343 to discuss same, in order that this application may be allowed and passed to issue at an early date.

Respectfully submitted,



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